

AN INTRODUCTION TO PROGRAMMING AND OZOBOT

AN OZOBOT TUTORIAL FOR THE HOUR OF CODE™

Hour of Code™

What is the Hour of Code? The Hour of Code is a nationwide initiative by Computer Science Education Week (www.csedweek.org) and Code.org (www.code.org) to introduce millions of students to one hour of computer science and computer programming. The idea is to introduce the concept of coding to students and letting them know that anyone can code!

The following is a planner created by Ozobot that suggests a lesson that can be used for the Hour of Code. This lesson is “unplugged”, which means that the coding is not done on a computer or tablet, but on a piece of paper. Actually, you will be giving commands to Ozobot using OzoCodes, which are special color sequences. This is also a form of programming even if no computer is being used!

This tutorial introduces your students to programming and computational thinking, but it also explains what kind of robot Ozobot is. There is also a slightly different tutorial available that covers the same topics but focuses more on the Ozocodes. If you are interested, please also take a look at the tutorial “Programming with Colors – An Ozobot Tutorial for the Hour of Code”.

The type of visual programming that your students are going to learn in this lesson is particularly well suited for younger students without any prior programming experience, since it is not intimidating and uses markers which kids are very familiar with. Therefore, this tutorial can be used very well as an introduction to programming for the Hour of Code. Please find more information about the Hour of Code™ here <https://hourofcode.com>.

What students will learn

- What kind of a robot is Ozobot?
- How does Ozobot sense its environment and move in it?
- How can you program Ozobot with colors?

Topics

- Robotics: line following and color sensing
- Physics: optics
- Computer science: visual coding and computational thinking

Prerequisites

No programming experience or knowledge of Ozobot is required.

Maze challenge

Use visual codes to navigate paths to deterministically arrive at the finish point.

Real-life connection

Examples of other line-following robots and their industrial and commercial applications

Common Core Standards

CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them.

CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically.

CCSS.MATH.PRACTICE.MP7 Look for and make use of structure.

- ISTE
- 1.c – Use models and simulation to explore complex systems and issues
 - 4.b – Plan and manage activities to develop a solution or complete a project
 - 6.a – Understand and use technology systems

Age/Grade level

Grades K-12

STEM topics

- inter-disciplinary: robotics, physics and math come together to create a line-following robot
- computer science: use visual codes and computational thinking to program the robot

Grouping

Lessons can be done individually or in groups of two or three students.

Materials

- Ozobots (1 per group of about 3 students), charged
- Blank white paper, a few sheets per group
- Markers in colors black, red, blue and green (we recommend you use Ozobot markers).

Alternatively, choose Sharpie's wide chisel tip or Crayola classic markers), one set per group

- Printouts #1-3, one each per group, but have a couple of extra copies of #1 and 3 in case students make a mistake
- Printout of OzoCodes reference chart (<http://files.ozobot.com/stem-education/ozobot-ozocodes-reference.pdf>), one per group
- Printout of Ozobot Tips sheet <http://files.ozobot.com/stem-education/ozobot-tips.pdf>, one per group
- Optional: printout of lesson plan, one per group, if students are learning self-guided

Estimated duration

1 hour, can be extended to two class sessions

Tips

For more info on how to plan your event for the Hour of Code, please take a look at the Hour of Code website <https://hourofcode.com/how-to/events>.

You can also sign up your event there. Other great pages to help you plan are:

<https://hourofcode.com/how-to>

<https://hourofcode.com/promote/resources>

Beyond this Lesson

After completing this lesson, students should be comfortable programming Ozobot with markers, lines, and OzoCodes. As the next step, you may want to do another lesson using the OzoCodes. You can see all of these lessons in the OzoCodes section of the Ozobot Lesson Library here <http://portal.ozobot.com/lessons/list/ozocodes>.

Contact

Please contact us at ozoedu@ozobot.com with any question about Ozobot or this lesson plan.

LESSON

1. Introduction to Coding

"How many of you have heard of computer code? Today we are going to learn what coding is, and actually program a robot to move a specific way!"

1. As a class, brainstorm the steps for arriving at and crossing an intersection in a car.
 - a. Start by allowing the kids to come up with ideas without input from you.
 - b. Write the steps on white board, cards or paper strips so they can be moved around and edited instructions inserted.
 - c. As the steps develop, question the students so they see where the steps need to be more specific. Add details to the instructions.
2. Show video: <https://www.youtube.com/watch?v=THOEQ5soVpY> about "What is coding?", or any of the inspirational videos from the Hour of Code website <https://hourofcode.com/us/promote/resources#videos>.

2. What is Ozobot?

"We are going to learn how to program the robot Ozobot. But first we have to learn a bit more about this robot. What can it do and how does it work?"

Ozobot is a miniature robot, the smallest of its kind, and there are a lot of things Ozobot can do. Ozobot's most basic ability is following lines. You can draw a line, place Ozobot on it and it will follow the line.

Draw a black line (1/4", 6mm in width) on a white piece of paper. Turn Ozobot on by pressing the button on the side. Place Ozobot on the line.

How does this work?

Turn Ozobot over and see what's underneath. On the bottom, you can see 5 openings with lights shining out of them. An optical sensor lives in each of these openings. These sensors are Ozobot's eyes. Each of the sensors sees how bright the paper underneath is. This way, Ozobot can see where the white and where the black parts are and therefore knows where the line is.

3. How to take care of Ozobot

It may happen that Ozobot starts behaving strangely. For example, Ozobot may stop to be able to follow lines. To prevent this from happening, do the following maintenance every time you start playing with Ozobot or whenever you change your location or type of paper:

1) Calibrate

What does this mean? Ozobot's "eyes" (the sensors) are very sensitive to the surrounding light. So much so that, if the paper changes or if you go closer to the window, it affects how Ozobot sees what's underneath. To let Ozobot know what its surroundings are, you need to calibrate:

Use the Ozobot Tip Sheet and follow the instructions to calibrate your Ozobot.

After calibrating, Ozobot knows how dark the black lines are, how white the paper in the background is and how much light is in the room.

Sometimes, calibration alone is not enough and you may want to:

2) Clean the wheels

Ozobot is very small, so just a bit of dust or grease can get into the drivetrain. It's like driving through a dirty, muddy field with a car. You would certainly want to give the car a good cleaning afterwards. But don't try to clean Ozobot with soap and water, this would most certainly break Ozobot. Instead, take a clean white sheet of paper and move Ozobot's wheels gently back and forth on the paper. Done, Ozobot's wheels are clean!

Lastly, you will have to charge Ozobot periodically:

3) Charge the battery

Ozobot's motor is fueled by a tiny battery, much like cell phones, but smaller. If Ozobot blinks red, then the battery needs charging very soon. Plug the special USB cable to a computer and plug Ozobot to the cable. When the battery is almost charged fully, Ozobot starts blinking green. Ozobot shows a solid green light when the battery is completely charged.

4. Ozobot can see colors

Continue drawing lines with different color segments: blue, green, red. Let Ozobot drive on these lines and see how Ozobot reads those colors and the LED in Ozobot's dome shines in that color.

How does it work?

The middle sensor is actually a color sensor. It can detect red, green and blue colors. And, since every color can be mixed using these three colors, Ozobot can see all of them.

5. You can give commands to Ozobot.

You can give Ozobot commands by using colors.

Use printout #1: In any of the slots, mark (blue, black, blue) and (red, black, red) and (blue, green, blue). Place Ozobot on the line and see how Ozobot understands the colors.

What you drew on the paper are codes that Ozobot can understand. As Ozobot drives along the line, Ozobot sees the color sequence red black red. Ozobot has been programmed at the factory to know that this means: "drive slowly". As you have probably seen by now, the other codes mean "fast" and "turbo speed".

There are many different other codes that Ozobot knows. Take a look at the OzoCode reference chart to see some of them.

Optional: on a piece of blank papers, try out some of the codes. Make sure to draw a black line before and after each code. For more tips, please see the "Ozobot Tips" sheet .

6. Order does matter

Use printout #2: Place Ozobot onto the track at any point and observe which movements Ozobot reads.

These 4 codes are the different “cool moves” from the OzoCode reference chart. Notice that the code for “Tornado” is the reverse of “Spin” and “Zigzag” the reverse of “Backwalk”. And you can see on the track how it works: if Ozobot reads the code (red, green, red, green), then Ozobot does the tornado move. Now, if Ozobot sees the code with the colors reversed (green, red, green, red), then Ozobot spins.

Some codes are symmetric, for example “Slow” or “Fast”, so it doesn’t matter if Ozobot reads them from left to right or right to left. But many codes are not symmetric, like the ones you have just tried out. Make sure that you rotate them according to how Ozobot reads them. All codes on the reference chart are oriented to be read from left to right.

7. Are there other line-following robots?

Yes, a lot of line-following robots are used in factories, warehouses, hospitals and even restaurants! Some of the earliest Automated Guided Vehicles (AGVs) were line following mobile robots. They might follow a visual line painted or embedded in the floor or ceiling or an electrical wire in the floor.

The first AGV was invented in the 1950s and at the time it was simply a tow truck that followed a wire in the floor. Today, AGVs are used in nearly every industry: transporting materials for assembly lines, products in warehouses, but also food in restaurants or medicine in hospitals.



Maze Exercise

To review everything we learned today, take a look at the handout #3.

Can you help Ozobot find the way to the shop across the river? On the right is your house and Ozobot needs to take you from the house to the shop. But Ozobot might end up at the river with no place to go. So it is up to you to guide Ozobot with the help of codes. Make sure that when Ozobot starts at home, Ozobot always arrives at shop.

To accomplish this, fill in the codes on the bottom left of handout #3 into the empty spaces on the road. You have to use all codes, but you can use each of them only once. Once you have filled in all spaces, turn Ozobot on and place Ozobot on the line at the "Place here" marker. Does Ozobot arrive at the shop? Repeat this a couple of times. If you found you have made a mistake, take another copy and fill in the codes differently.





